PATENT ABSTRACTS OF JAPAN

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(54) RECORDING AND REPRODUCING SYSTEM FOR INFORMATION SIGNAL, ITS RECORDING AND REPRODUCING DEVICE, HEAD DEVICE FOR RECORDING AND REPRODUCING, MEMORY MEDIUM, HEAD ELEMENT AND MANUFACTURE OF THE HEAD ELEMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To enable to process an information signal with high recording density, at high access speed and at high data transfer speed by opposing a head device provided with plural head elements having a flat part of an area of ≤ the specific value at a tip to a memory medium provided with a flat recording plane, and moving relatively the memory medium and the head device at longer distance than distance between adjacent head elements.
SOLUTION: A head device 30 is provided with many head elements 1 having a flat part of ≤0.1 μm2 in a matrix state corresponding to each sector of a memory medium by 1:1 in the prescribed two dimensional arrangement. The head device 30 is contacted to the memory medium 20 in which an information signal is previously recorded in each sector ruggedly, an electric field is applied between time memory medium 20 and the head element 1 from a power source 11 and an information signal is reproduced. Thereby, an ROM system and a Writable memory system having access speed of a μs order, recording density of 1-10 GB/cm2, and data transfer speed of a Gbit/s order can be obtained.

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CLAIMS

[Claim(s)]

[Claim 1] It is 2 0.1 micrometers at a tip. Head component for recording the information signal characterized by forming the record cell size of a memory medium, or the flat part of 1/10 or more area with an area of 1 bit below, or reproducing.

[Claim 2] The head component to which the point of a head component is perpendicularly characterized by the long pillar-shaped and formed thing to a substrate side.

[Claim 3] The head component characterized by being formed by the non-conductive member which the point of claim 1 and a head component according to claim 2 cannot adjoin the conductive member and this conductive part which record or detect an information signal, and cannot record or detect an information signal.

[Claim 4] Head equipment characterized by arranging two or more places of a head component according to claim 1 to 3 two-dimensional on the surface of a substrate in the pitch of a law.

[Claim 5] A head component according to claim 1 to 3 is 25 heads / cm2 on the same substrate two or more. Head equipment characterized by being formed by the above consistency.

[Claim 6] The head component according to claim 2 to 5 or head equipment

characterized by the substrate consisting of conductive substrates.
[Claim 7] Head equipment characterized by equipping two or more head components with the device which only a predetermined distance can move perpendicularly in independent to a substrate side, respectively, and forming them.
[Claim 8] The head component according to claim 1 to 7 or head equipment characterized by the minute distance drive of said each head component being carried out by electrostatic force or the piezo-electric effect to X shaft orientations, Y shaft orientations, or both sides.
[Claim 9] The memory medium characterized by forming an address signal with the information signal which it is going to record on a recording surface two-dimensional.
[Claim 10] The memory medium characterized by forming the address signal in a recording surface two-dimensional in the concavo-convex pit.
[Claim 11] The memory medium characterized by being divided into the information signal record sector of the head element number and the same number of the head equipment according to claim 4 to 8 with which the recording surface of an information signal tends to record or reproduce an information signal.
[Claim 12] The memory medium characterized by forming the irregularity corresponding to an information signal in a front face of injection molding or extrusion molding.
[Claim 13] The memory medium according to claim 9 to 12 which the substrate was formed with the conductive ingredient or is characterized by forming the conductive layer of a thin film in the front face of a non-conductive substrate.
[Claim 14] The memory medium according to claim 13 characterized by covering the recording surface with the diamond[carbon or]-like carbon thin film with conductivity.
[Claim 15] The memory medium by which an impedance is characterized by being covered with the thin film of the ingredient which changes locally between said head components an impression front and after impression when the front face of the substrate with which irregularity was formed in a flat substrate or a flat part without irregularity impresses local electric field, a current, heat, and a pressure with a head component.
[Claim 16] It is arranged two-dimensional by the memory medium equipped with the flat recording surface, and is 2 0.1 micrometers at a tip. Head equipment equipped with two or more head components in which the flat part of the following area is formed is made to counter. Moving said memory medium and said head equipment relatively beyond the distance between said adjoining head components It is an information signal to

the predetermined location of said recording surface 1 Gbit/cm2 Play back system of the information signal characterized by reproducing the information signal of said format which records in the form of the above recording density, or is beforehand recorded on said predetermined recording surface with said head equipment.
[Claim 17] It is 1 Gbit/cm2 to each sector formed in the recording surface of a memory medium according to claim 11. Play back system of the information signal characterized by what it distributes into said sector from which the information signal of the same information signal sequence differs in the form of the irregularity of the above recording density, and is recorded or recorded on it.
[Claim 18] Claim 16 characterized by reproducing the information signal which an information signal is recorded on the recording surface of a memory medium in the form of irregularity, or is recorded on said recording surface in the form of irregularity, and the play back system of an information signal according to claim 17.
[Claim 19] The play back system of the information signal according to claim 18 characterized by reproducing the information signal recorded on the recording surface in the form of irregularity by detecting the impedance between said head component which impresses electric field between said head components and recording surfaces of said memory medium, and changes with said irregularity corresponding to an information signal, and said memory medium.
[Claim 20] The play back system of the information signal according to claim 19 characterized by reproducing the information signal recorded on the recording surface in the form of irregularity by detecting the impedance between said head components and recording surfaces of said memory medium while the point of said head component does not contact said crevice but contacts only heights.
[Claim 21] The play back system of the information signal according to claim 16 to 18 characterized by impressing the electric field of a frequency higher than the mechanical primary resonance frequency of the mechanical component of head equipment between the point of said head component, and the recording surface of said memory medium, detecting the current modulated according to the information signal, and reproducing an information signal.
[Claim 22] The play back system of the information signal according to claim 16 to 21 characterized by recording an information signal or reproducing in the condition of having made some head components of said head equipment countering the recording surface of said memory medium, moving said head equipment and said memory medium relatively.

[Claim 23] The memory medium equipped with the flat information signal recording surface, and the head equipment which countered in parallel with said information signal recording surface of this memory medium, and was arranged and with which two or more places of a head component according to claim 1 are arranged two-dimensional in the pitch of a law, The impression equipment which impresses electric field, a current, heat, or a pressure between said information signal recording surface of said memory medium, and said each head component, The driving gear to which a microscopic small distance relative target is made to move said memory medium and head equipment, the record regenerative circuit which takes out the information signal which supplies the information signal which it is going to record on each head component of said head equipment, or detected the information signal with which said each head component is recorded -- since -- the record regenerative apparatus of the information signal characterized by being constituted.

[Claim 24] Said impression equipment is a record regenerative apparatus of the information signal according to claim 24 characterized by impressing the electric field of a frequency higher than the mechanical primary resonance frequency of said mechanical component between the point of each head component of said head equipment, and the recording surface of said memory medium.

[Claim 25] The 1st process which forms the sacrifice layer which consists of a resist so that a center section may become cross-section trapezoidal shape at the flat surface of a flat conductive substrate, The 2nd process which forms a metal membrane with a thickness of 1-several micrometers covering the flat surface of said conductive substrate from the front face of said sacrifice layer, The 3rd process which forms a symmetrical spring pattern in the trapezoid center section of said metal membrane, The 4th process at which one side forms the resist film of the minute area below said metal membrane in the center section of said spring pattern, Until just before said minute resist film and metal membrane dissociate completely, said metal membrane is etched. the 6th process which forms the spring which removes the 5th process which forms the minute head component by which the flat part was formed at the tip, and said sacrifice layer and said minute resist film, and supports said minute head component flexibly by said metal membrane -- since -- the manufacture approach of the becoming minute head component.

[Claim 26] The 1st process which forms the insulator layer of predetermined thickness in the front face of the substrate which has conductivity on a front face at least, The 2nd process which gives a

mask to parts other than the part equivalent to the cross section of the pillar-shaped head component made into the manufacture purpose at the position of said insulator layer, The manufacture approach of the minute head component which consists of the 3rd process which removes said insulator layer of the part equivalent to the cross section of said pillar-shaped head component, and the 4th process which a metal is grown up into the part from which said insulator layer was removed by plating etc., and forms said pillar-shaped head component.
[Claim 27] The signal memorized by the superficial memory medium by which information is arranged and recorded two-dimensional In case it reproduces moving relatively the head component which countered in parallel with said information signal recording surface of the memory medium, and was arranged, and said memory medium Without carrying out tracking control of said head component to the predetermined signal train on said memory medium A regenerative signal is sampled two-dimensional at intervals of below one half of each period of the two-dimensional signal sequence on said memory medium. Make the specified quantity and data store temporarily at buffer memory, and the address signal which is the two-dimensional positional information memorized by said memory medium is identified out of said regenerative signal. By carrying out signal processing of the data stream stored in the relative velocity of the time amount by which said address signal was reproduced, said head component, and said memory medium, a direction, and said buffer memory The play back system of the information signal characterized by decoding the contents of data of the specific location for which it asks on said memory medium.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the play back system of the information signal for reproducing the information signal which records an information signal on a memory medium comparatively with high density and in digital one, or is beforehand recorded on the memory medium comparatively with high density and in digital one (or detection) and its head equipment for record playback, and a memory medium.
[0002]

[Description of the Prior Art] Although there is disk memory for which DRAM, the semiconductor memory represented by Flash memory, the magnetic tape represented by the videocassette recorder, a compact disk, and a hard disk are substituted as a bulk memory now, these have problems, like an access rate with a respectively high bit unit price is slow, and cannot master comfortably information I/O devices, such as a microprocessor, a network, etc. which a data transfer rate and data volume will go up increasingly from now on. The cost of per unit data (bit) of a hard disk, a conventional optical disk, or a conventional magnetic tape unit is cheap double or more figures as compared with semiconductor memory. However, the volume of the access time, a data transfer time, and equipment is inferior, so that it does not become semiconductor memory and a comparison.

[0003] Though the costs per bit are a magnetic disk and optical disk extent, that the volume of the access time, a data transfer time, and equipment realizes about the same memory only for playbacks as semiconductor memory and recordable memory is ideal memory whose huge-izing and improvement in the speed of the amount of data which are dealt with by improvement in the transmission speed in the engine performance and information network of a computer are increasing today.

[0004] The area which it is expected that the magnitude of a semiconductor chip becomes the generation of 4Gbit with about 3x3cm or more by being large for every generation in the case of DRAM, and includes a package in this case is 2 about 12cm. It becomes extent. In order to be dealt with like DRAM, it is desirable to make memory with a cheap bit unit price below in magnitude of this level. if it is desirable that the minimum and an animation can memorize for about 1 hour as storage capacity stored in the above-mentioned area and the digital picture signal with which the band was compressed is taken into consideration -- 12Gbit extent -- namely, -- at least -- 1 Gbit/cm2 It is necessary to have the recording density of extent.

[0005] There is memory using the so-called SPMs (Scanning Probe Microscope), such as STM (Scanning Tunneling Microscope) or AFM (Atomic Force Microscope), as what has possibility that the aforementioned demand can be met, and it inquires briskly.

[0006] For example, he is IBM by H. J. Mamin and others. It is introduced to J. Res. Develop. Vol. 39, 681 (1995) in detail. These have detected the information signal using head equipment 100 as shown in drawing 11 . This head equipment 100 is equipped with the head component 101 (it is only hereafter written as a "head component") whose tip of the beam generally called a cantilever 103 where the cantilever of the end was

fixed and carried out to the head substrate 102 is the signal detecting element keenly sharpened in configurations, such as four-sided three-sided pyramids, a pyramid, etc., according to the semi-conductor process as shown in drawing 11 B. The tip of the head component 101 which sharpened keenly to the level of atomic size was made to approach a data front face in the case of the front face of a device under test, and memory, and information has been acquired by detecting directly or indirectly the force between atoms committed between the head component 101 and a device-under-test front face, or the tunnel current which flows in the meantime.

[0007] B. D. Terris and others produced Appl. Phys. Lett. 69(27) and a data pattern applicable [with an electron beam exposure system] to a disk-like medium 4262 (1996), it imprinted to the UV-cured resin layer formed on the glass disk by glass 2P so-called approach in the pattern, data were produced, and it has reported having reproduced the data signal memorized by the disk by AFM.

[0008] Moreover, by contacting the tip of AFM to a macromolecule substrate, heating the tip of AFM by laser, and carrying out melting of the front face of a macromolecule substrate with the heat, H. J. Mamin and others records data, is performing high-speed playback by AFM, and has obtained the result of 1 Mbits/sec as data reproduction speed (H. Sensors andActuators A48, 215 (1995) by J. Mamin and others.). Furthermore, record playback is performed with the record regenerative apparatus of the information signal in these reports again, rotating disk media using one AFM head.

[0009] And H. Kado and others is Appl. Phys. Lett. 66 (22) 2961 (1995) again. A platinum thin film is formed on a silicon substrate, and it is amorphous GeSb2 Te4 on it further. Membranes are formed, it records by adding pulse electrolysis between a conductive acute head component and a platinum thin film, and playback is performed by detecting the difference in conductivity as current change.

[0010]

[Problem(s) to be Solved by the Invention] However, in detection of the data in said AFM, since the force between said atoms was changed into mechanical displacement of a cantilever 103 and has detected the variation rate with the piezoresistance condenser or the laser displacement gage, it is not suitable for high-speed playback. Moreover, a record medium is a disk-like, in performing record playback of an information signal, rotating a disk, rotational delay takes time amount and there is a fault that an access rate becomes slow.

[0011] In order to improve an effectual data transfer rate, there is the

approach of using two or more head equipments and carrying out parallel processing. For example, S.C.Minne and others is Appl.Phys.Lett.67 (26) 3918 (1995). The tip of a head component arranges in juxtaposition two AMF head equipments detached 100 micrometers, and is reproducing the image of the grating in a cycle of 5 micrometer. In this parallel processor, in order to make the variation rate of the two cantilevers carry out separately in the depth direction, ZnO which has the piezo-electric effect is used for a part of cantilever, in order to secure the amount of displacement enough, a cantilever becomes large (die length of 420 micrometers, width of face of 85 micrometers), as that result, a mechanical resonance frequency becomes low and the data transfer rate is slow. Therefore, when two or more AFM head equipments are used, a data transfer rate does not improve so much.

[0012] Moreover, in the data regenerative apparatus (microscope) using two or more head components which are in this bibliography, the method and device which get to know or amend the physical relationship of the data of each head component in an parallel direction and a request to a measuring plane-ed are not reported, but it also has the problem that address administration of data important as a memory apparatus cannot be performed. Though the distance between each head component and physical relationship are known clearly and physical relationship with the address of a data surface was beforehand found about any one head component, for example, it originates in the difference in the coefficient of thermal expansion of a head array when there is a temperature change, and a storage substrate etc., and the relative relation between each head component and a corresponding data location cannot be maintained.

[0013] Furthermore, when the tip of the head component 101 of head equipment 100 is very sharp, a certain impact is added during data playback and a head component and a data surface contact again in order that there may be no part which has possibility of contacting a data surface in addition to the point of a head component as the memory apparatus using SPM showed to drawing 11 , there is a danger of a local very high pressure being added and destroying data. For example, Sensors and Actuators A48,215 (1955) by S.C.Minne and others The point of a head component is spherical then and it is reported that the curvature is 100nm or less. Moreover, the load rate of a cantilever is the order of 1 N/m. A certain impact is added and the case where the tip of a head component displaces to a data surface side, and collides with a data surface only 10nm is considered. Here, it is considered that the tip of a head component is a flat circle with a radius of 10nm. In this case,

the pressure which joins a flat circle is 3x107 N/m2. It becomes, a very high pressure will be added and destruction is not escaped with the usual ingredient. Moreover, when data are not destroyed, and wearing the tip of a head component out, the configuration at the tip changes, and if it forces, the problem that the resolution of record or playback falls is also produced.

[0014] And since said H. Kado's and others record playback approaches are 10pA(s) in the location where, as for the current value at the time of playback, record is not performed, and are 1nA in the location after record, and the regenerative-signal band is narrow when data reproduction speed is slow, S/N of sufficient regenerative signal is obtained, but since a signal frequency band spreads when data reproduction speed is early, S/N of regenerative signal with the signal current sufficient with 1nA extent is not secured again. As described above, there are many problems also in SPM.

[0015] This invention is the access rate of mus order, and 1 - 10 GB/cm2, without solving such many problems and destroying data. It aims at obtaining the play back system of the information signal of the data using ROM and the Writable memory medium which have recording density and the data transfer rate of Gbit/sec etc.

[0016]

[Means for Solving the Problem] Therefore, this invention is arranged by the memory medium equipped with the flat recording surface two-dimensional. It is 2 0.1 micrometers at a tip. Moving said memory medium and said head equipment relatively beyond the distance between said head components which head equipment equipped with two or more head components in which the flat part of the following area is formed is made to counter, and adjoin It is an information signal to the predetermined location of said recording surface 1 Gbit/cm2 The play back system of the information signal which reproduces the information signal of said format which records in the form of the above recording density, or is beforehand recorded on said predetermined recording surface with said head equipment was taken, and said technical problem is solved.

[0017] Therefore, it will be an information signal if the play back system of the information signal of this invention is taken 1 Gbit/cm2 It can record with the above high recording density, and, moreover, an information signal can be processed with the access rate of mus order, and the data transfer rate of Gbit/sec.

[0018]

[Embodiment of the Invention] Hereafter, the example of this invention

is explained using drawing. First, the various head components of this invention are explained using drawing 1 thru/or drawing 4 . drawing 1 -- this invention -- the -- one -- an example -- being shown -- a head -- a component -- a point -- a configuration -- being shown -- a part -- expansion -- a side elevation -- it is -- drawing 2 -- this invention -- the -- two -- an example -- being shown -- a head -- a component -- a point -- a configuration -- being shown -- a part -- expansion -- a side elevation -- it is -- drawing 3 -- this invention -- the -- three -- an example -- being shown -- a head -- a component -- a point -- a configuration -- be shown -- a part -- expansion -- a side elevation -- it is -- and -- drawing 4 -- this invention -- the -- four -- an example -- be shown -- a head -- a component -- a point -- a configuration -- be shown -- a part -- expansion -- a side elevation -- it is .

[0019] First, the head component of the 1st example of this invention is explained using drawing 1 . As shown in drawing 11 B, when the tip of the conventional head component is sharp, so that it can also detect change of atomic size level and it expanded, it was regarded as the semi-sphere of very small curvature, and when a head component and a memory medium contacted, the local very high pressure arose, and it mentioned above that there was a possibility that the data on a memory medium may be destroyed. The head component which solved this fault to drawing 1 was illustrated. In drawing 1 , sign 1A points out the head component of this invention. In order that this head component 1A may reduce the pressure which joins a memory medium at the time of said collision, the point 2 of head component 1A which is an information signal detecting element or an information signal detection electrode is evenly formed, as the sign 3 showed. The magnitude at the tip of head component 1A is 1 Gbit/cm2. When it takes into consideration detecting the information signal currently recorded by the above consistency, it is 2 that it is large 0.1 micrometers. It is necessary to be the following.

[0020] Since the force at the time of a collision is distributed so that the area used as a flat part 3 is large, the probability of data corruption is reduced. For example, the cell size of the data which it is going to reproduce (detection) is 0.1x0.1 micrometers, and when making a judgment of "1" of data, and "0" by whether there is any crevice of this magnitude, or there is nothing, it is good at extent same as spatial resolving power at the time of playback as cell size. Temporarily, it becomes the square whose one side is 0.05 micrometers from the circle whose touch area at the time of the collision which the magnitude of the flat part 3 of one half of the 0.05x0.05 micrometers,

then the head component 1A points 2 of cell size was comparable, was good, and took up resolution by the term of the trouble of the conventional technique is the radius of 10nm, and becomes about 8 times by surface ratio, and the impact at the time of a collision is reduced so much. In addition, the thing whose front face does not point out a perfect flat condition and is somewhat ruined, or comparable as data-cell size or the configuration which has the loose curvature beyond it is sufficient as the semantics of the "flatness" used here.

[0021] If constituted from structure which forms the periphery 4 of the point 2 with conductivity with a non-conductive ingredient like [although it is effective at least in make the point of a head component flat reduce the impact at the time of a collision] head component 1B of the 2nd example of this invention shown in drawing 2 , and does not extend substantially the area of the flat part 3 of said point 2 which is the information signal Records Department or a detecting element , but extends a touch area with the memory medium at the time of a collision , it will become much more effective .

[0022] Moreover, the surface smoothness of the point 2 can be secured still more easily by forming the point 2 in the front face of the substrate 5 of a non-conductive ingredient in the shape of a thin film like the pyramid used for the conventional AFM etc. in the configuration of the point of a head component, or head component 1C of the 3rd example of this invention shown in drawing 3 rather than needlelike. If it is the configuration of the point 2 of head component 1B shown in this head component 1C and drawing 2 , in reproducing the memory medium by which the information signal is recorded by irregularity (storage), for example Since the flat part 3 of these points 2 can be made large compared with the area of the crevice of a memory medium, There is effectiveness which essentially prevents the error of the regenerative signal produced when those points 2 do not eat into a crevice accidentally, therefore a point 2 eats into a crevice accidentally, or mechanical destruction of a data surface.

[0023] Furthermore, like head component 1D of the 4th example of this invention shown in drawing 4 , even if the edge of the point 2 is deleted by wear by forming the point 2 in the front face of a substrate 5 with column-like structure, the magnitude of a point 2 does not change again. That is, the spatial resolving power of record or playback does not fall.

[0024] As mentioned above, on the other hand, we are anxious about degradation of the data surface of the memory medium by friction and wear by making the area of the flat part of the point of each head

component expand, and making a touch area large. It is desirable for coefficient of friction to form a conductive ingredient with a large degree of hardness in either or both sides small for protection of the data surface of a memory medium or the point 2 of a head component. For example, it is good to cover the film of carbon or hydrogenation carbon (diamond-like carbon) with a spatter or a CVD method. Furthermore, it is also effective to apply the lubricant of polymeric materials thinly on such film. Although it is desirable to have conductivity as for macromolecule lubricant, even if it is insulation, when thickness is thin, playback by alternating current can be performed.

[0025] Next, the solution approach which accelerates data playback is explained. In order to reproduce mass data in an instant, it is required to make quick to make a data transfer rate quick and an access rate. In order to make a data transfer rate quick, it is important for the playback system restricted with securing S/N sufficient also by the wide band, and the resonance frequency of a machine to use the playback approach which does not essentially have a limit at a rate. Although the spatial resolving power of AFM and STM etc. is very high, it is difficult to acquire a big regenerative signal because of the output by very feeble force or currents, such as force between atoms, or tunnel current. Therefore, it is difficult to obtain S/N sufficient in a broadband.

[0026] Then, the playback system of the information signal of this invention makes "1" or "0" data correspond to the switch of a current, and the playback approach reproduced by whether a current flows or it does not flow is used for it. Drawing 5 is the conceptual diagram of the regenerative apparatus of the information signal which is an example for explaining the play back system of the information signal of this invention, drawing 6 is used for the play back system of the information signal of this invention, and it is the notional top view of a suitable memory medium, and drawing 7 is used for the play back system of the information signal of this invention, and is the notional top view of suitable head equipment.

[0027] In drawing 5 , a sign 10 points out the record regenerative apparatus of the information signal which is the example of this invention. This record regenerative apparatus 10 consists of the memory medium 20 shown in 6, head equipment 30 shown in drawing 7 , a power source 11, amplifier 12, etc. In addition, in this specification, only not only equipment equipped with both the functions of "record and playback" but "record" refuses to also contain the equipment of a function or a "reproductive" function beforehand with the "record

regenerative apparatus." As were shown in drawing 5 and drawing 7 , and the memory medium 20 of this invention is the thing of the structure where the conductive layer 22 was formed on the plate-like conductive substrate 21 of a quadrilateral and was shown in drawing 6 , the recording surface of the conductive layer 22 It records on two or more sectors 23 which they are at the unit of the data area on the memory medium 20 by which one specific head component 1 can be reproduced at a break at the shape of a go board side, and an information signal is recorded on each sector 23 concave convex.

[0028] Moreover, said head equipment 30 is predetermined two-dimensional array on a substrate 5, respectively about many head components 1 (any of said head components 1A, 1B, and 1C are sufficient), as shown in drawing 5 and drawing 7 . For example, the distance between heads of the direction of X which each sector 23 of said memory medium 20 is made to correspond in the direction of X and the direction of Y by 1 to 1, and adjoins at least in the shape of a matrix (pitch) is Pa, and the head pitch of the direction of Y is formed by Pb. That is, one head component 1 takes charge of one sector 23 as a record section or a playback field.

[0029] Next, the playback approach of the information signal of this invention using the record regenerative apparatus 10 of this invention is explained. Although a principle in case an information signal contacts said head equipment 30 to said memory medium 20 beforehand recorded on each sector 23 by concave convex and is reproduced is shown in drawing 5 , electric field are imposed from a power source 11 between the conductive substrate 21 of the memory medium 20, and the head component 1. Although not illustrated, only when the device for contacting both moderately is established and the head component 1 contacts the heights of the memory medium 20, to the head component 1 and the memory medium 20, a current flows from the head component 1 to the memory medium 20. A big signal level is obtained by carrying out current potential conversion and amplifying this current with amplifier 12.

[0030] For example, it is current density when the touch area in contact with the memory medium 20 of the head component 1 is 0.05x0.05 micrometers 5x108 A/m2 If it assumes, only when the head component 1 contacts heights, the current of 1.4microA will flow. Supposing resistance of 500hm(s) performs current potential conversion, output voltage will be set to 70 microvolts, and sufficient S/N is obtained even if a regenerative-signal band is 10MHz. When 500hm(s) are used as resistance which performs current potential conversion, as a noise in the case of being ideal, the thermal noise of resistance becomes

dominant. The thermal-noise current at the time of setting a signal band to 10MHz and setting temperature to 300K is calculated with 57nA(s). The signal current required in order to reproduce a digital signal, without being prevented by this noise current is low, and desirably needed 570 nAs 200 nAs. the touch area which will contact the memory medium 20 of the head component 1 if playback with the aforementioned current density is assumed -- being small -- 0.0004micrometer2 -- desirable -- 0.0011micrometer2 It becomes extent. If the contact section is made into a square, it will become the magnitude of 0.02x0.02 micrometers and 0.033x0.033 micrometers, respectively.

[0031] An alternating current is sufficient although the electric field of a direct current are impressed to the head component 1 in the example shown in drawing 5 . It is more desirable to impress the high alternating current electric field of a frequency, when the very thin insulating layer is formed in the head component 1 or the playback front face of the memory medium 20, or when the tooth space with very thin air etc. is formed between the head component 1 and the playback front face of the memory medium 20.

[0032] Moreover, in using the focal device in which the memory medium 20 and head equipment 30 are contacted according to electrostatic force, also in order for there to be a possibility that the electric field for signal detection and the electric field for focal devices may interfere and to avoid it, as for the electric field for signal detection, it is desirable an alternating current and to use a frequency quite higher than the resonance frequency of the moving part of head equipment 30 moreover.

[0033] Above H.Kado and others is Appl.Phys.Lett.66 (22) 2961 (1995). As reported, it is amorphous GeSb2 Te4. Although it uses and the information signal is reproduced using the recordable memory medium using change of the conductivity before record and after record, since the regenerative-signal current is as feeble as 1nA, high-speed playback is difficult. If it is going to enlarge the current value used for playback, since the conductivity of the non-recorded part of the memory medium 20 will change (i.e., since record will be performed), this has been produced from constraint that a large current cannot be taken. In order to enlarge a current at the time of playback, it is necessary to enlarge the current value from which record into a non-recorded part begins, and it is effective in it whether the presentation of an ingredient and thickness are changed or the configuration of a head component is changed.

[0034] Like said example, by the memory medium 20 only for playbacks,

since there were few worries about record, the upper limit of a current was able to be raised. Record is possible (Writable). By the memory medium of a mold, although the control approach of a recording start current changes with mechanisms of record, it can divide roughly into that to which record is performed by the heat generally generated by passing a current, the thing to which record is performed by the high electric field made locally, and the thing which records with the pressure at the time of the collision with a head component (probe) and a memory medium. By these record mechanisms, as each makes the tip of a head component (probe) acute, it becomes more difficult for a recording start current to become small, therefore to acquire the big regenerative current. It is desirable it to be desirable to make the tip of a head component (probe) into flat structure, and for this to acquire the regenerative-signal current of 10 or more nAs also from such a viewpoint.

[0035] In order to perform rapid access, moving part is small as much as possible, it is light, and it is desirable for migration length to be short. With disk-media use equipments, such as a hard disk drive unit and an optical disk unit, one head per 1st page of recording surface is carried, and it usually consists of structure which moves by the swing arm or the linear actuator to radial [of a disk]. The access rate to a radius location [****] is improvable so that much magnetic heads may be arranged in radial and migration length per piece may be lessened to such disk media, but in fact, since the cost per piece being high and the volume of the magnetic head or an optical head are also large, there is a fault that a memory apparatus becomes large and the method of arranging much magnetic heads as mentioned above, and improving an access rate is not taken.

[0036] However, the head equipment 30 of this invention can be used as a multi-head as an example was shown in (a postscript being carried out) since it is very small and production of two or more head components is also easy, and drawing 5 . In addition, two or more heads can be arranged in radial [of the memory medium which rotates like a disk, for example], and all recording information signals can be made to access, when each head makes it move to radial at least more than the pitch between contiguity heads. For example, since what is necessary is just to move 1mm when a head pitch is 1mm, it can access to a desired truck in an instant.

[0037] However, even if it takes such an approach, rotation mold disk media surely take the time amount of rotational delay. The rotational frequency of disk media is raised, and although there is also the approach of rotating at high speed, there is a problem with the

stability of a spindle motor, and dependability. In this invention, as shown in drawing 5 thru/or drawing 7 , using the head equipment 30 which arranged two or more head components 1 in the shape of a matrix, this head equipment 30 is contacted to the recording surface of the memory medium 20, and when only the pitch P of the head component 1 moves relatively that head equipment 30 and memory medium 20, the access rate is raised. Migration in the XY direction can be performed by moving the movable stage where it is equipped with head equipment 30 by the stepping motor, the DC motor, and the piezo actuator. the pitch P of the head component 1 -- the consistency of 2mm1, i.e., the head component of head equipment 30, -- 25 head component / cm2 it is -- a case -- the near migration length to a data location -- 1mm -- it is -- an actuator -- if an average drive rate is carried out in 1m/s, an access rate will be set to 1ms and will become early several or more times as compared with the rotational delay in the conventional rotation mold disk media. Furthermore, an access rate can be set to 100 microseconds if the pitch P of a head component is shortened with 0.2mm.

[0038] As mentioned above, when reproducing the information signal currently recorded on the memory medium 20 by the head equipment 30 possessing two or more head components 1, the data of two or more sectors 23 of the memory medium 20 can be reproduced to coincidence with two or more head components 1. If the sector 23 from which it differs on the memory medium 20 is distributed and the long information signal is beforehand recorded rather than it reproduces the long information signal by one head component 1 continuously when it is an information signal with long die length The recorded long information signal is reproducible in a short time by making two or more head components 1 of head equipment 30 counter two or more sectors 23 at the time of playback, and scanning to coincidence.

[0039] Moreover, if an information signal is distributed and it records as mentioned above besides the problem of reproduction speed, when the data of a certain sector 23 are destroyed or a certain head component 1 breaks down, errorless playback can be performed by it becoming impossible to reproduce all data and using a suitable error collection. Therefore, it is effective to distribute and record an information signal on a different sector 23.

[0040] Furthermore, by distributing the information signal of the same information signal sequence as two or more set combination and a different record regenerative apparatus 10 for the record regenerative apparatus 10 of the information signal by the combination of said head equipment 30 and memory medium 20, and performing record or playback,

dependability can be raised or an effectual data transfer rate can be raised.

[0041] Next, the addressing approach in said record regenerative apparatus 10 is explained. It is necessary to get to know whether the desired information signal is recorded on the location of memory medium 20 throat in playback of an information signal, and to make head equipment 30 access it to the location. For that purpose, it is required to get to know the positional information of an information signal and to move the head component 1 to the location (field inboard and the depth direction). Alignment in field inboard (X, the direction of Y) is made for convenience to call the alignment to "positioning" and the depth direction "focusing" for convenience here.

[0042] In order to make each head component 1 of said head equipment 30 counter each sector 23 of said memory medium 20 and to perform positioning of the head component 1 to each sector 23 at the time of record or playback, the approach of making move the head equipment 30 whole, or performing by fixing head equipment 30 and moving the memory medium 20 is desirable. In order to perform positioning, the distance which each head component 1 must move to field inboard is a pitch P grade between the head components 1 which adjoin mostly. For example, when the pitch P between the head component 1 is 0.1x0.1mm, it must be able to move 0.1mm or more. Temporarily, if it is going to perform positioning independently for each head component of every, the actuator which each head component 1 can move 0.1mm or more, respectively must be provided. That is, the device to which only the pitch P between the adjoining head components 1 is moved must be formed in less than 1 spacing of each head component, and this is a difficult thing. It is not a problem to move the head equipment 30 whole about 0.1mm to this approach at all.

[0043] It is **, and it becomes disadvantageous in performing detailed positioning of the head component 1 of each when moving head equipment 30, and an information signal location to reproduce. This is because the error of the alignment produced with the error of the pitch P between the head components 1 produced at the time of production of head equipment 30, the error of information signal spacing produced at the time of production of the memory medium 20 or change of an operating environment, for example, temperature, and humidity when the expansion coefficients of the memory medium 20 and head equipment 30 differ cannot be amended. In order to amend this error (this is hereafter called "fine positioning"), it is effective to make the minute actuator which can carry out distance migration provide for every head component. Since it

is enough as compared with the case where the above makes it move 0.1mm, in the case of this fine positioning if only many 1/10 of distance of the pitch P between the head components 1 can be moved as an estimate, it can fully respond with the small actuator using a piezoelectric device, for example. Therefore, control of the head equipment 30 in this invention is performed in two steps of positioning (course positioning) to which the head equipment 30 whole is moved, and fine positioning to which each head component 1 is moved minutely.

[0044] There is the record playback approach simplified more besides these two step controls. Performing only course positioning, fine positioning is an approach which is not performed. In this case, it is the approach of reproducing the information signal of the circumference of it collectively after making it moving to a location performing the location or record which wants to reproduce each head component 1 by course positioning about, or recording, accumulating the information signal acquired about playback in buffer memory, and specifying the data of a position by signal processing after that. An information signal gathers and is recorded for example, on one train, and if this train is called a truck, reproducing an information signal along a truck will turn into playback in the condition of not being hung, i.e., tracking. In this case, if an information signal is reproduced with the period beyond twice of the period (pitch) of a truck at least, restoration of an information signal will be attained by next signal processing. What is necessary is just to reproduce an information signal with the period beyond twice of the period in the direction of X, and each direction of Y, when the information signal is recorded on two-dimensional. Since the one larger in order to take the large signal current is good while it is desirable for spatial resolving power to be high as magnitude of the point of the head component 1 here, as die length of the head component 1, it is desirable that it is 1/2 or less [of the pitch of said truck / 1/10 or more].

[0045] Moreover, the information signal accumulated to buffer memory has the desirable digital signal which is not continuation in time, in order to perform signal processing easily. It is desirable that it is below one half of the time amount which moves a signal with an actuator by course positioning as a sampling period incorporated to buffer memory by the die length equivalent to the cell size of an information signal or 1 bit.

[0046] Although focusing is unnecessary when the memory medium 20 and head equipment 30 have smooth nature and very good smoothness, it is difficult to maintain smoothness by deformation by temperature and

humidity, the curvature by membranous stress, etc. in fact. For example, the magnitude of the memory medium 20 is 2 2x2mm. When the include angle of curvature considers as 2 times, at the both ends of the memory medium 20, 70-micrometer height will differ in the depth direction. The 2 step-control approach is effective like [in such a case] the aforementioned case difficult [it / to give the actuator ability to which a distance of this level is moved for every head component like the aforementioned positioning] therefore.

[0047] As what plays a role of rough focusing, the method of making flat head equipment 30 and the memory medium 20 is easy, and desirable. It sticks [at the time of record playback / on a flat stage] the memory medium 20 using the ingredient which an elastic modulus is large to the substrate of an elastic modulus being large into both substrate ingredient for that purpose, and using what has thick thickness, and head equipment 30, an elastic modulus is small to the substrate of the memory medium 20 on the other hand using what has thick thickness, and whose thickness is thin, and can deform easily or holds down with head equipment 30. Desired display flatness can be obtained by taking such a means. As an ingredient with a large elastic modulus which does not produce deformation, metals, such as ceramics, such as glass, silicon, aluminum, and stainless steel, are useful, and polymeric materials, such as an acrylic, a polycarbonate, and nylon, are useful as an ingredient which deforms easily. Moreover, it is effective in adhesion to a stage or head equipment 30 to use electrostatic force.

[0048] As for fine focusing, it is desirable to make the actuator style which about 10 micrometers or less can move in the depth direction independently of each head component 1 carry. For example, it is realizable by using electrostatic force or a piezoelectric device. Since it can judge by carrying out the monitor of the impedance in a regenerative-signal system or a record circuit, whether the head component 1 touches the memory medium 20 hangs feedback using this signal, and it is controllable to stability. One of the fine focusing device of this may be prepared per [which may prepare in each head component 1, and adjoins as mentioned above] two or more head components 1.

[0049] Apart from the information signal, the address signal for telling a relative position with the memory medium 20 to the head component 1 or head equipment 30 is recorded on the memory medium 20. An address signal is a signal which tells the two-dimensional positional information in a sector 23, may be beforehand recorded on the memory medium 20 with irregularity, and may use the signal recorded with head equipment 30 at

the time of record.
[0050] Next, the production approach of said memory medium 20 is explained. As for the memory medium 20 only for playbacks, it is desirable to use as a signal the detailed irregularity formed in the substrate front face. The original recording in which the detailed concavo-convex pattern was formed with phot lithography or electron-beam-lithography equipment can be produced like a compact disk, and it can form by the substrate and one by injection molding or extrusion molding by making this into metal mold. Or separately, ultraviolet-rays hardening resin can be applied and irregularity can be formed in a substrate by 2P so-called law (Photo Polymerization) at this. As a substrate, others, glass, or a metal etc. can be used. [polymeric materials /, such as an acrylic and a polycarbonate,]
[0051] The recordable memory medium 20 forms the ingredient from which the impedance of the head component 1 and the memory medium 20 changes with impression of local electric field, a current, heat, a pressure, etc. locally an impression front and after impression on the substrate by which irregularity was formed in a flat substrate or the object for address signals without irregularity by the above approaches at some memory media 20. As such an ingredient, it is amorphous GeSb2 Te4 which is looked at by said bibliography, for example. The polymeric materials which dissolve and deform by heat or the pressure, the capacitor which accumulates a charge, or a ferroelectric ingredient can be mentioned.
[0052] The head component 1 or head equipment 30 can use and form a semi-conductor process on flat substrates, such as silicon and glass. The moving part for fine focusing forms by the membrane from which it was supported by the cantilever and the both-ends restrained beam with the micro-machining technique, and it was supported by the substrate with the beam. In the substrate of head equipment 30, ICs, such as a controller for focus servos, a head amplifier, and a current driver, may be accumulated and carried.
[0053] Next, the example of the production approach of head equipment 30 is explained using drawing 8 thru/or drawing 10 . Drawing 8 is process drawing of the first half of the production processes for explaining the manufacture approach of the head equipment of the 1st example of this invention, and drawing 9 is process drawing of the second half which ranks second to the first half process of drawing 8 , and drawing 10 is a production process Fig. for explaining the manufacture approach of the head equipment of the 2nd example of this invention.
[0054] First, in the process (1) of drawing 8 , the substrate 31 of a silicon wafer with comparatively high (that is, it has conductivity)

high impurity concentration is prepared as a thing equivalent to the substrate 5 of said head equipment 30. Circuits, such as a digital disposal circuit and a current driver, may already be formed. Next, in a process (2), the cross section called a sacrifice layer to the front face of said substrate 31 with a micro-machining technique forms deposition of the film of the configuration of trapezoidal shape by patterning. This deposition is behind removed by etching. an ingredient -- a photoresist, aluminum, and SiO2 etc. -- it chooses suitably by balance with the ingredient used henceforth. Here, the photoresist after exposure and development is used as it is. A sign 32 is this photoresist pattern.

[0055] In the following process (3), an ingredient with a thickness of 1-several micrometers it is thin to the spring member which moves in the vertical direction behind for a fine focusing device is formed. The aluminium alloy 33 is used in the example. And as shown in the process (4), patterning 34 of said aluminium alloy film 33 is performed. This patterning 34 gives the role of two or more springs to the aluminium alloy 33 of the photoresist pattern 32 of said trapezoid configuration mostly formed on the center section, and that periphery is fixed to the periphery of a substrate 31. Drawing B of a process (4) is a sectional view on the A-A line in drawing A.

[0056] Next, in a process (5), one side forms the pattern of the minute square below the thickness of an aluminium alloy 33 in the center section of said aluminium alloy 33 of the photoresist 32 of said trapezoid configuration mostly formed on the center section by the photoresist 35. And at the following process (6), isotropic etching is performed for said aluminium alloy 33 using phosphoric acid. When etching progresses, before the photoresist 35 and aluminium alloy 33 of said square separate completely, etching is ended, and it is made for a flat part to remain at the tip of an aluminium alloy 33 at this time.

[0057] This is annealed in the gas ambient atmosphere which contains oxygen at the following process (7). By annealing, the stress produced into aluminium alloy 33 part can be eased, and the front face of the aluminium alloy 33 of parts other than the point part (part in contact with the minute photoresist 35) of a head component is oxidized, and the front face is made to insulation.

[0058] A resist remover removes the photoresist 32 and the minute photoresist 35 of a trapezoid configuration at a process (8) after this annealing treatment. in this way -- between aluminium alloy 33 part and substrates 31 (equivalent to the substrate 5 in drawing 3 and drawing 4) -- a cavity 6 -- becoming -- the aluminium alloy 33 of the trapezoid

configuration of the cavernous 6 upper part -- a spring 7 -- becoming -- the center section of the spring 7 -- a tip 2 -- flatness -- it means that the head component [three] 1 was formed In addition, the sign given to this head component takes and attaches the sign and adjustment which were given to the head component shown in drawing 3 and drawing 4 .
[0059] and the aluminium alloy flat part which finally installs an electrode in a silicon substrate 31, impresses a DC-bias electrical potential difference, and has conductivity on a front face -- alternative -- amorphous hydrogenation carbon -- CVD (Chemical Vapor Deposition) -- membranes can be formed by law and the desired head component 1 can be obtained. In addition, although only the head component for one piece was illustrated and explained to drawing 8 and drawing 9 which were used for explanation of this example, if the production process of this example is used, it will add that many head components can be formed on a substrate 31 at coincidence, and much head equipments 30 can be manufactured to coincidence.
[0060] Next, the manufacture approach of the head equipment of the 2nd example of this invention is explained using drawing 10 . This manufacture approach is for manufacturing pillar-shaped head component 1D shown in drawing 4 . First, in a process (1), it covers by the film 42 of an about 1-micrometer thick insulating ingredient on the front face of the substrate 41 which has conductivity on a front face at least. As an ingredient of this insulating film 42, oxidization silicon, silicon nitride, a photoresist, polyimide, etc. can be used, for example.
[0061] Next, in a process (2), a mask 43 is formed in parts other than the part equivalent to the pillar-shaped point of a head component with the ingredient which is equal to etching of said insulating film 42. It is desirable to use for formation of this mask 43 the phot lithography by ultraviolet rays with short wavelength like the X ray lithography or the ArF excimer laser which used synchrotron radiation.
[0062] Then, it is RIE (Reactive Ion Etching) about the insulating film 42 of the part which is equivalent to the point of head component 1D at a process (3). It removes in different direction and the tip formation section 44 is formed. Next, a mask 43 is removed and a point 2 is formed in said tip formation section 44 with metals, such as nickel, by plating by using the conductive substrate 41 as an electrode by the following process (4). After a point 2 is formed, finishing polish for improving the surface smoothness on the front face of a tip is performed. It has the pillar-shaped point 2 as shown in drawing 4 in this way, and head component 1D is obtained. Also in this example, although the condition that only the head component for one piece was formed was illustrated

and explained to used drawing 10 , if the production process of this example is used, it will add that many head components can be formed on a substrate 41 at coincidence, and much head equipments 30 can be manufactured to coincidence.

[0063]

[Effect of the Invention] According to [so that clearly from the above explanation] the play back system and its record regenerative apparatus of an information signal of this invention, it is the access rate of mus order, and 1-10GB/cm2. The ROM system and Writable memory system which have recording density and the data transfer rate of Gbit/s order can be obtained.

[0064] Therefore, although the record regenerative apparatus of the information signal of this invention is inferior in respect of speed and dependability compared with semiconductor memory, since it has the difference of double or more figures at bit cost, it is applicable in the various directions of a technique. That is, the replacement of application which uses optical disks, such as CD, MD, an electronic game machine, DVD, and a video camera, and magnetic recording can be considered. It is effective for the permutation of hard disks, such as a Walkman with which portability is asked especially, a digital camera and also laptop, and a personal digital assistant.

[0065] Furthermore, the play back system and its record regenerative apparatus of an information signal of this invention are very effective in the application to the data bank recognition databases with which the huge amount of data is treated, and high-speed search and rapid access are demanded, such as speech recognition and image recognition, or for video demand distribution etc.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] the configuration of the point of a head component which shows the 1st example of this invention is shown -- it is an expansion side elevation a part.

[Drawing 2] the configuration of the point of a head component which shows the 2nd example of this invention is shown -- it is an expansion side elevation a part.

[Drawing 3] the configuration of the point of a head component which

shows the 3rd example of this invention is shown -- it is an expansion side elevation a part.
[Drawing 4] the configuration of the point of a head component which shows the 4th example of this invention is shown -- it is an expansion side elevation a part.
[Drawing 5] It is a conceptual diagram for explaining the play back system of the information signal of this invention.
[Drawing 6] It uses for the play back system of the information signal of this invention, and is the notional top view of a suitable memory medium.
[Drawing 7] It uses for the play back system of the information signal of this invention, and is the notional top view of suitable head equipment.
[Drawing 8] It is process drawing of the first half of the production processes for explaining the manufacture approach of the head equipment of the 1st example of this invention.
[Drawing 9] It is process drawing of the second half which ranks second to the first half process of drawing 8 .
[Drawing 10] It is a production process Fig. for explaining the manufacture approach of the head equipment of the 2nd example of this invention.
[Drawing 11] the conceptual diagram of the head equipment of the conventional technique -- it is -- this drawing A -- the side elevation said drawing B -- a part of the head component -- it is an expansion side elevation.
[Description of Notations]
They are [-- A periphery, 5 / -- A substrate, 7 / -- A spring, 10 / -- The record regenerative apparatus of the information signal of this invention, 11 / -- A power source, 12 / -- Amplifier, 20 / -- A memory medium, 21 / -- A conductive substrate, 22 / -- A conductive layer, 23 / -- A sector, 30 / -- Head equipment of this invention] 1A, 1B, 1C, and 1D. -- The head component of the example of this invention, 2 -- A point, 3 -- A flat part, 4